

DEPARTMENT OF THE INTERIOR
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INFORMATION CIRCULAR

PROGRESS IN SAFETY IN COAL MINING
IN THE UNITED STATES



BY

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During the 5-year period 1906-10 inclusive, 84 major disasters (a major disaster being one in which 5 or more lives are lost) occurred in the coal mines of the United States, or an average of 17 per year, and the total number of fatalities from coal-mine gas and dust explosions (major plus minor) for the 5 years aggregated 2,338 or 477.6 per year. The monotonous continuance of coal-mine disasters month by month aroused the people of the United States to such an extent that it was felt necessary for the Federal Government to try to do something looking to the avoidance of the admittedly excessive loss of life in our coal mines, and this was one of the deciding factors in the establishment of the United States Bureau of Mines in 1910. That results have been obtained in this particular cause of coal-mine accidents may be seen from the fact that for the year 1933 but one major explosion disaster occurred in the coal mines of the United States and the total number killed in that disaster was 7. Unquestionably the coal-mining industry through use of safer mining practices and aided by the various kinds of work of the Bureau of Mines looking to the prevention of mine fires and explosions is in large part responsible for this very creditable change.

If the gas and dust explosion fatality rate of 1.059 per million tons of coal produced during the period 1906-10 inclusive had continued to the first of January 1934, instead of the 6,373 deaths which actually occurred due to gas and dust explosions, there would have been 13,480. Hence, during the 23 years existence of the Bureau of Mines there has apparently been a saving of about 7,102 probable deaths, or an average of more than 300 per year, from gas and dust explosions as against the number which would have occurred had the 1.059 gas and dust explosion fatality rate for the period 1906-10 continued. Thirty-nine persons were killed in all kinds of explosions (both major and minor) in the coal mines of the United States in 1933; if the 1.059 gas and dust fatality rate of the 1906-10 period had been in effect in 1933, about 400 persons would have been killed. Unquestionably, the various teachings of the U.S. Bureau of Mines looking to the avoidance of explosions and fires in mines have had a vital influence in reducing the number of explosions and fires and also in decreasing their destruction in case they occur.

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During the past 6 or 7 years, rock-dusting long advocated by the Bureau of Mines unquestionably has been instrumental annually in the saving of 200 or more lives through limiting explosions which have been started or through preventing explosions from getting a start.

During the 5-year period 1906-10, inclusive, 13,238 persons were killed in the coal mines of the United States, an average of 2,658 per year, and the fatality rate for this 5-year period was 5.89 persons killed per million tons of coal produced. The number killed in our coal mines in 1932 (the latest date for which complete figures are available), was 1,207, and the fatality rate per million tons of coal produced was 3.36, next to the lowest fatality rate in the recorded history of coal mining in the United States, the lowest rate (3.31) having been established in 1931; tentative figures for 1933 indicate that 1,013 fatalities occurred, with fatality rate 2.63, by far the lowest number killed as well as the lowest coal-mining fatality rate on record.

The number of fatalities as well as the fatality rate per million tons of coal produced have fallen steadily (though with a few "peaks" in isolated years.) The significance as well as the magnitude of this decrease in the coal-mining fatality rate is apparent when it is known that if the 3.89 fatality rate for the 5-year period 1906-10 had continued to the first of January 1934 the number of fatalities in the coal mines of the United States would have been 24,300 greater than they actually were; hence, during the 23 years life of the Bureau of Mines the fatality rate has been reduced sufficiently to indicate an average annual saving of life of more than 1,000 persons; similar figures as to prevention of nonfatal accidents are not available, but it is estimated that about 50 nonfatal accidents occur to one fatality hence it is probable that nonfatal accidents to the number of around 50,000 annually have also been eliminated. If the cost to the operator of a life is put into cold-blooded dollars and cents figures and a relatively low amount such as \$5,000 is taken as the "value" of a life, it will readily be seen that, irrespective of ethical or humanitarian considerations and not considering nonfatal accidents, the annual saving of somewhat more than 1,000 lives may be considered as "worth" more than \$5,000,000 or almost 5 times the total amount being expended by the Bureau of Mines during the present fiscal year and nearly double the entire expenditure of the Bureau for any year of its existence. If in addition it is conceded that as many as 50,000 nonfatal accidents per year have been prevented (and the assumption is by no means a wild one) and the "cost" to the operator in compensation, hospitalization, etc., of a nonfatal accident is placed at \$100.00, it will be seen that at least an additional \$5,000,000 has been saved to the coal industry through the safer operation of the past 23 years.

The benefits to the workers in and around coal mines due to this increased safety of operation are much more impressive than are those to the mine operator. The prevention of the death of 24,300 coal-mine workers in the past 23 years has obviously prevented a vast amount of suffering, pain, and misery of various kinds to the families who would have been bereft of

their loved one. And the prevention of 50,000 or more nonfatal accidents annually for 23 years certainly has saved the miners, their families, their friends, and the community a large amount of pain, inconvenience, misery, and other losses of a similar nature.

The financial losses which the workers have avoided through this increased safety of coal-mine operation are in themselves colossal. The average age of the coal-mine worker who is killed is about 35 years and, in general, he should under normal conditions have a future active working period of at least 20 years. In normal times he should earn at least \$1,000 annually, hence in his 20 years active life expectancy would receive approximately \$20,000 for his services. Hence the saving of the life of about 24,300 coal-mine workers in the past 23 years through decreased death rate in coal mining has prevented a financial loss to them of at least \$486,000,000, and this does not take into consideration the financial losses saved to the worker through the elimination of large numbers of nonfatal accidents. Hence for the past 23 years an annual saving of upwards of \$21,000,000 has been made to coal-mine workers in the prevention of fatalities; \$21,000,000 is far more than the total expenditures on safety work by the U. S. Bureau of Mines since its establishment in 1910, therefore the coal-mine worker unquestionably is reaping annual dividends of several hundred (probably several thousand) percent on the expenditures of the Federal Government in the promotion of safety in coal mining.

While, unquestionably, progress has been made towards the safe operation of coal mines, much if not most of it in the past 5 years, it would be a terrible mistake to assume that the ultimate in safe operation of coal mines has been reached, as this is anything but the truth. The latest available statistics indicate that coal mining still has the highest or worst accident rate of the major industries of the United States--and that the industrial accident rate of the United States is the highest or worst of the countries of the world with the exception of Chile. While progress has been made and is being made towards safer operation of our coal mines, the work has only begun, and the end should not be at hand until accident occurrence in our mines (coal, metal, and nonmetallic) has been reduced at least 75 percent below what it is at present.

Unquestionably many, probably most, old timers in coal mining including both officials and workers, on reading the above statement will immediately say that it is utterly out of the question to reduce "present-day accident occurrence" at least 75 percent. Their conclusion could not have been very successfully refuted as late as 6 or 7 years ago; however, since about 1925 so many instances are available of reduction in accident frequency, accident severity, and accident cost of 90 percent or over as compared with past records that placing the figures for accident reduction at 75 percent is well within the bounds of conservatism.

An excellent illustration of what can be done and how to do it as well as the result of reasonably well directed effort is illustrated in the

following paragraphs, taken from a talk by a prominent coal-mining operating executive, and the data which follow indicating some of the relatively recent accomplishments of his organization:

I was born in a mining camp and have spent all of my life within a stone's throw of a coal mine or in some phase of work connected therewith. I think I am reasonably familiar with the attitude of the average operator towards safety as well as the attitude of the average miner towards safety. Frankness is one of the requisites for successful safety work, therefore, at the risk of criticism, I will be frank with you on my own attitude towards safety until about five years ago. Along with the various members of our supervisory force, I permitted myself to believe that safety and efficiency were words which could not be uttered in the same breath. Accidents were something that just simply happened in every coal mine and little or nothing could be done about it. The average miner would not cooperate in accident prevention work. On the contrary, he was hostile. Effective safety work increased the cost of production. The practice of Safety First slowed down production. Organized safety work as required by insurance companies was something to be done at a minimum of cost and effort because it amounted to nothing in the end. In the interest of what I thought was efficiency, I permitted practices that were subsequently shown to be both unsafe and inefficient. I feared to be frank on responsibility for accidents because I was being told that we were "getting by" with thus and so and if the matter were thoroughly aired, we would suffer in production costs. I did not want injuries or fatalities any more than I do now. I simply was possessed of a feeling of helplessness.

I know that what I have just told you very frankly of my attitude is no different from the old-time attitude of the average operating man from the top to the bottom. I also know that in making such frank admissions, I am opening up the way for criticism of myself, yet I believe so sincerely in safety work that I am willing to take such a chance if my own experience will be helpful to others. However, I don't want to be greeted with any headlines such as "Coal Operator Makes Startling Admissions." I want to add here that the accident experience at our properties at that time was no worse than the average, and even at that was some better than that which prevailed at some mines where loud but insincere safety work was being done. * * *

Many mining men do not yet believe that safety and efficiency go hand in hand. A careful study of any given piece of work will disclose safe and unsafe ways as well as efficient and inefficient ways. The combination of safe with efficient invariably produces a result which over even a short period of time results in lower costs. The desired combination is never reached without using one's brain.

The common belief among mining men is that organized safety is costly. Nothing could be farther from the truth. The appearance on the pay roll of a safety engineer, the appearance of monthly invoices for safety signs, literature, prizes, and what not, should give no broad-gage operator any pang of concern. The efficiency which comes as a byproduct from safety work offsets the cost. The real price to be paid for safety is brain work. Most of us are lazy mentally and do not like to think. If we can overcome that laziness and really think about safety, the battle is won and the cost is small. * * *

Little has been said about results. At -- we now employ 1,500 men. We have our own hospital of 24 beds and staff of surgeon and three nurses. On my last visit to the hospital several weeks ago, I did not find a single patient confined there. I think that tells the story. Safety work is a very definite part of my duties. During the past few years of strife and turmoil, when accomplishment of anything seemed impossible, safety work has stood out as something on which results could be shown.

The company under the operating supervision of the man who relatively recently made the above statements reduced its accident frequency from 340.15 in 1929 to 74.04 in 1933, or over 78 percent in the 5 years, and reduced its accident severity from 43.74 in 1929 to 2.09 in 1933, or over 95 percent in the 5 years, and in addition has produced nearly 2,400,000 tons of coal since the last fatality. Moreover, the cost of the safety work of this company, making this impressive demonstration of improvement in safety in coal-mine operation, is given as considerably less than 1/2 cent per ton of coal produced. This figure on the cost of safety work compares very favorably with the 10 or more cents per ton now generally believed to represent the cost of accidents in the coal mines of the United States.

Numerous instances are available of heavy decrease in the rate of accident occurrence in coal mining during approximately the past 4, 5, or 6 years: One large producer of coal in the period 1930 to 1933, inclusive, reduced accident frequency 89.2 percent, accident severity 97.2 percent, and the direct cost (compensation plus hospitalization) 91.3 percent, or from \$0.08 per ton in 1930 to \$0.007 per ton in 1933; another large producing coal company reduced accident severity from 22.10 in 1929 to 1.93 in 1933 or more than 90 percent; another reduced accident frequency 75 percent between 1929 and 1933; and so on.

Prior to about 1925, few if any coal-mine operators even thought of trying to operate a fairly large capacity coal mine for a year or even a month without a lost-time accident, and most coal operators felt decidedly fortunate in working a good-sized mine as long as a year without one or more fatalities. As indicative of the change not only in the attitude of mind of many coal-mining people during the past few years but also in accomplishment in safety of operation, it is significant that during 1933 at least 12 coal mines had records of having operated an entire year or more without a lost-time accident;

the 12 coal mines or companies produced an aggregate of 2,368,000 tons of coal without a lost-time accident, the smallest having produced about 70,000 tons and the largest practically 380,000 tons in the year or more of operation without a lost-time accident, the average production of the 12 mines being nearly 198,000 tons in the no-lost-time accident period.

One coal mine now has hauled nearly 1,268,000 tons without a lost-time accident, another has produced approximately 1,400,000 tons without a lost-time accident to its tippie force, and one has not had a lost-time roof-fall accident in the production of more than 900,000 tons. Numerous records are available of production of 1,000,000 or 2,000,000 or more tons of coal without a fatality, and some coal mines have worked 10, 20, or even 30 or more years without a fatality, and numerous instances are at hand of individuals who have worked 10, 20, 30, 40, 50, or more years in coal mines without a lost-time accident.

Present day thought throws upon the shoulders of the operating officials and especially the face bosses much of the responsibility for avoidance of accidents in and around mines; and face, section, or division bosses in coal mines now are establishing decidedly good records of avoidance of lost-time accidents to employees under their supervision or guidance. One assistant foreman has not had a lost-time accident to his working force in approximately 262,000 man-hours of exposure to workers; another sub-boss has safeguarded his charges for 240,000 man-hours without a lost-time accident; and several others have exceeded 200,000 man-hours of exposure without a lost-time accident to workers under their supervision.

While only a few of the really praiseworthy records of safe operation of various phases of coal mining have been given and many others are available, yet it is rather a sad fact that probably not to exceed 20 percent, certainly not to exceed 30 percent, of those who operate or work in or around our coal mines are convinced that coal mines can be conducted without occurrence of accidents or at any rate with occurrence of not to exceed 10 percent of the present accident rate of most of our coal mines. Here is a real problem, and it is probable that the solution lies almost wholly in education and that compulsion methods are likely to be effective only to a limited extent.

While many bituminous mines in the United States are protecting their employees by using many if not most of the available safety methods and equipment, numerous mines, for one reason or another (usually inconsequential), fail to observe common-sense up-to-date safety requirements, and as a result our bituminous coal mines have the poorest accident experience and accident rates of coal mining in any nation in the world. The adoption and country-wide enforcement of certain minimum safety requirements would go far towards bringing to our bituminous coal-mine workers a degree of safety in their work to which they are justly entitled.

Recent investigations reveal that at least 10 percent (and in some cases much more than 10 percent) of the mine cost of producing bituminous coal is

due to accidents, this amounting to between \$30,000,000 and \$50,000,000 per year for the United States. Many companies by using up-to-date safety methods have reduced their accident costs as much as 95 percent; it is conservatively estimated that accident costs for the bituminous industry of the country as a whole can readily be reduced at least 50 percent. Moreover, if all bituminous coal mines were required to use certain minimum safety requirements, numerous inequalities in mine operating costs would be equalized, to the advantage not only of the workers but also of the right-minded operators and ultimately the general public.

When mine disasters with heavy loss of life occur, or when single fatalities or even minor accidents occur, much of the burden finally falls upon the coal-consuming public, or the public at large, as the high cost of accidents to the mine operator is ultimately passed on to the user of coal. In addition, while the compensation payments received by victims of accidents or their dependents help them temporarily, in general the families of crippled or killed miners, or the crippled miners themselves, become to a large extent dependent upon the public in one manner or other for support for several years following an accident and possibly continuously as long as they live.

Unquestionably, the coal-mining industry should operate under safety and health requirements at least as comprehensive as those listed below if our coal mines and our coal miners are to have anything like the safety conditions which they ought to have and which they can be given:

- (a) Every mine should maintain an actively functioning safety organization.
- (b) All foremen, safety inspectors, shot-firers, and bosses in charge of underground workers should have certificates of competency, preferably issued by the State upon passing a rigid examination.
- (c) Every mine should be given a rigid safety examination within 2 hours before the working shift is allowed to enter.
- (d) Every mine should maintain at least two travelable means of escape.
- (e) Every person working underground should be checked into and out of the mine.
- (f) All accidents should be reported to an appropriate governmental agency with at least a carbon copy of every such report to the U.S. Bureau of Mines.
- (g) Every person working in or about a mine should have first-aid training.
- (h) All mines should establish and keep in effect a systematic method of timbering; defining the minimum spacing of supports and allowing for additional supports where there is necessity for them.

(i) All working places in mines should be visited at least twice during the working shift by a competent supervising official, who should see that necessary safety precautions are being taken by the workers.

(j) All underground blasting should be by permissible explosives while the working shift is out of the mine.

(k) All mines should be adequately ventilated by mechanical equipment with main fan preferably located on the surface out of direct line of the air course leading to it. The oxygen content of working places should be maintained above 19 percent, methane below 1 1/2 percent, CO₂ below 1 percent and poisonous gases, such as CO, H₂S, or others, be removed by air currents or diluted so they are harmless.

(l) All mines which are not wet should be kept adequately rock-dusted except that the face region should be kept sprinkled to a distance at least 40 feet from the face and machine cuttings should be wet as the cutting is done.

(m) The open electrical equipment now used in bituminous-coal mines should gradually be replaced by permissible equipment.

(n) All bare power lines in mines should be adequately safeguarded throughout their length against contact by persons.

(o) No open-flame lights should be allowed underground.

(p) No internal-combustion engine should be used underground.

(q) Adequate clearance should be provided on all underground haulage roads for the protection of persons who must travel or work in those places.

(r) Openings to abandoned mines or parts of mines should be adequately sealed or protected against entrance of persons or animals.